Center Innovation Fund: LaRC CIF

Multi-Parameter Measurement in Unseeded Flows Using Femtosecond Lasers (Tier 2)

Completed Technology Project (2015 - 2016)

Project Introduction

We will take advantage of recent advancements in laser technology to explore new measurement techniques for NASA's wind tunnel facilities. Femtosecond (fs) lasers are 100,000x shorter pulse than typical 10 ns pulse lasers resulting in much higher power than existing previously laser technology. Can generates nonlinear effects: FLEET and FS CARS (FLEET = Femtosecond laser electronic excitation and tagging; CARS = Coherent anti-Stokes Raman Spectroscopy). Can use these techniques to measure velocity, temperature, pressure or density in wind tunnel flows with unprecedented precision accuracy. FLEET works very well in high pressure, low temperature N2 flows, such as our NTF. Such measurements will provide knowledge about flow fields as well as quantitative data for comparison with computations of the flow.

Anticipated Benefits

We are already using the FLEET technique to help NASA researchers better understand a flow-control device (swept jet actuator) which is being used in NASA's FAST-MAC project. FLEET could potentially be used in future FAST-MAC-type tests in NTF where the performance of the actuator can be evaluated in-situ for flow control. The technique could clearly show flow separation control, for example. While this project focuses on understanding and developing the physics to improve this new instrumentation, two parallel efforts (described in the comments section) are aimed at implementing the FLEET technology in NASA's large tunnels, including the National Transonic Facility. The technology is also highly relevant for supersonic and hypersonic applications where the technology can be used to characterize facilities and to study entry vehicles. The FS CARS pressure measurement capability, on the other hand, can be used to study sonic boom mitigation on supersonic aircraft.

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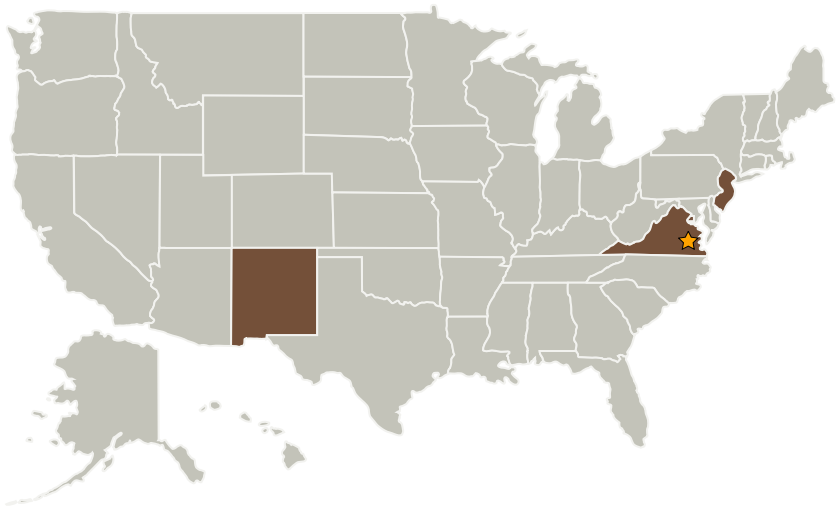
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
George Washington University	Supporting Organization	Academia	Washington, District of Columbia
Princeton University	Supporting Organization	Academia	Princeton, New Jersey
Sandia National Laboratories(SNL)	Supporting Organization	R&D Center	Albuquerque, New Mexico

Primary U.S. Work Locations	
District of Columbia	New Jersey
New Mexico	Virginia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Innovation Fund: LaRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

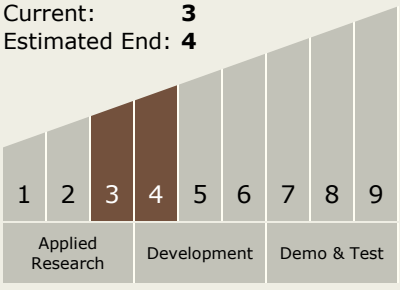
Julie A Williams-byrd

Principal Investigator:

Paul M Danehy

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



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Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.8 Ground and Flight Test Technologies